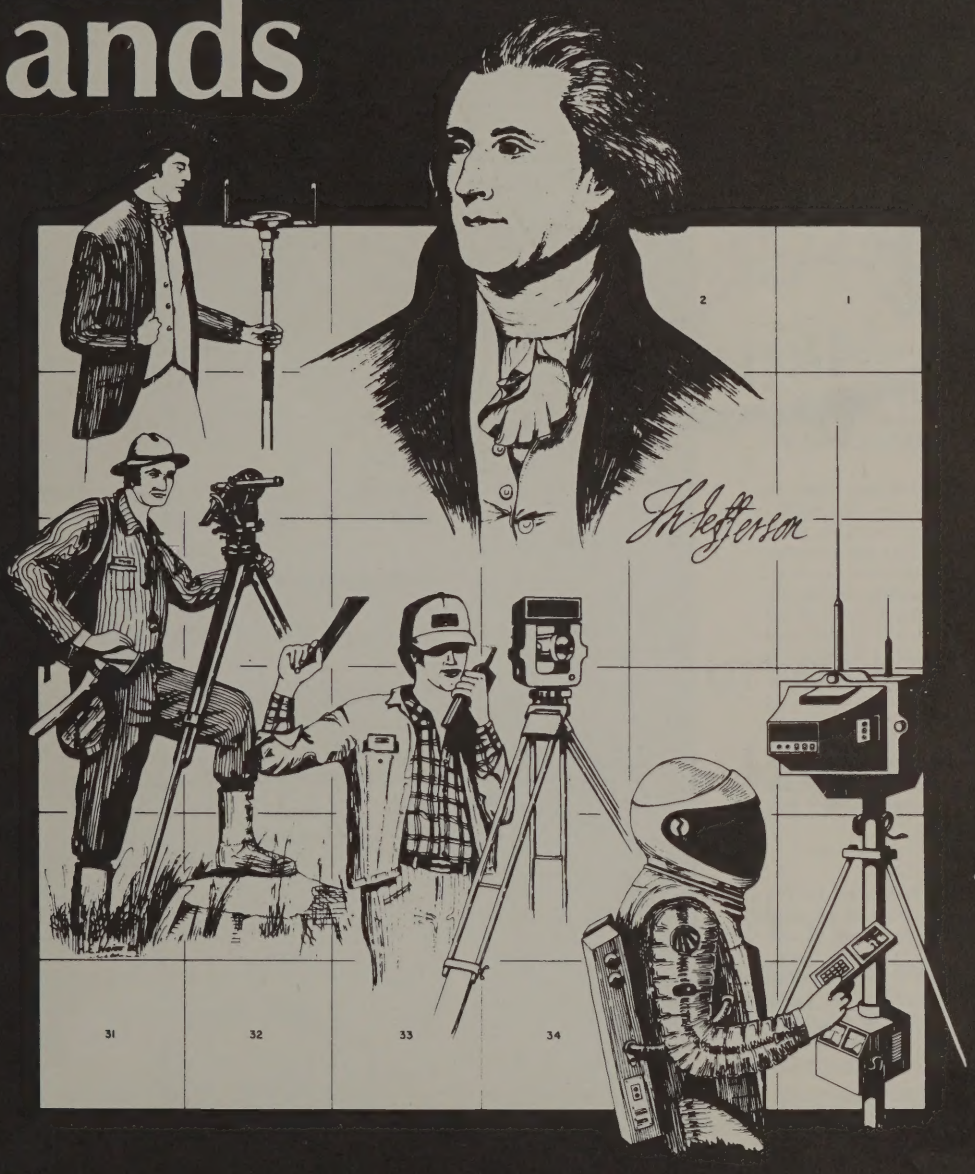
Your Public Lands

Spring 1986
Cadastral Survey 200th Anniversary Issue



UNITED STATES PUBLIC LAND SURVEY SYSTEM 1785-1985

CADASTRAL SURVEY 1785 1985 BICENTENNIAL

BICENTENNIAL

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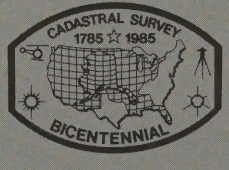

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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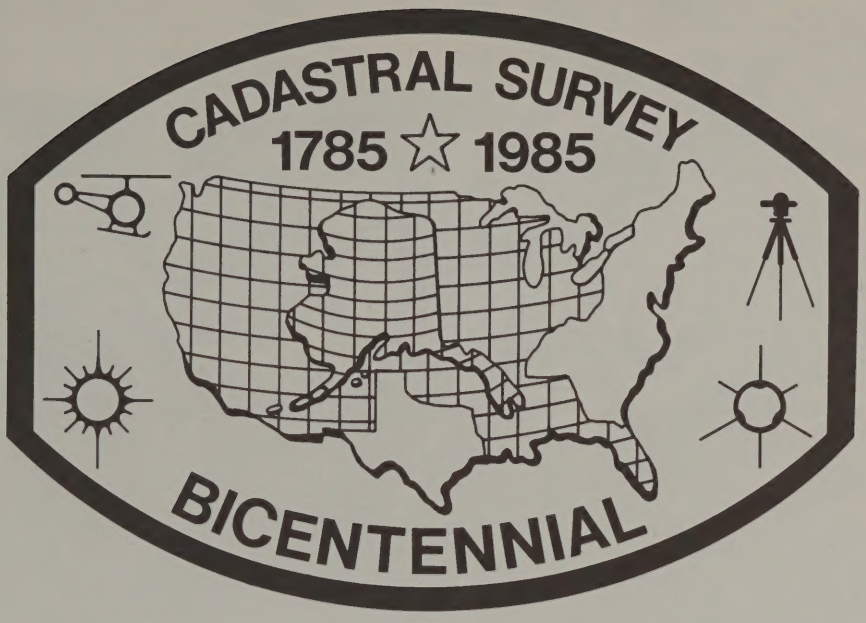
TIMELINE: SURVEY OF THE PUBLIC DOMAIN & RELATED EVENTS

1776 -- States confiscate Crown lands
Land bounties offered for patriotic service
1781 -- Thomas Hutchins appointed Geographer of the U.S.
1784 -- Thomas Jefferson named Chairman of committee to plan for locating and selling western lands
1785 -- Land Ordinance: Rectangular Survey System
Hutchins sets point of beginning for public land survey in Ohio
1796 -- Rufus Putnam appointed first Surveyor General of the U.S.
** Survey Office: Ohio and Northwest Territory
1803 -- Louisiana Purchase
** Survey Offices: Mississippi, Louisiana, Alabama
1812 -- General Land Office
1816 ** Survey Offices: Illinois and Missouri
1824 ** Survey Office: Florida
1832 ** Survey Office: Arkansas
1836 -- Surveyor William Burt patents solar compass
1839 ** Survey Offices: Wisconsin and Iowa
1848 -- Mexican Cession, Oregon Compromise
1849 -- Department of the Interior
1851 ** Survey Offices: California and Oregon
1854 ** Survey Offices: Kansas, Nebraska, and New Mexico
1855 ** Survey Offices: Washington and Utah
1857 ** Survey Office: Minnesota
1861 ** Survey Offices: Nevada, Colorado, North and South Dakota
1862 -- Homestead Act
1864 ** Survey Office: Arizona
1866 ** Survey Office: Idaho
1867 ** Survey Office: Montana
1869 -- Transcontinental railroad completed
1870 ** Survey Office: Wyoming
1884 ** Survey Office: Alaska
1910 -- End of contract surveys: District Survey System
(GLO hires surveyors as government employees)
Metal monuments replace stone markers
1934 -- Taylor Grazing Act
U. S. Grazing Service established
1946 -- Bureau of Land Management created by merger of General Land Office and U.S. Grazing Service
1940s - Theodolites introduced, replace magnetic and solar compases
1960s - EDM (Electronic Distance Measurement) equipment supplements theodolites
1980s - Total Station surveying Satellite technology used by surveyors.



Public Land Survey System
1785 — 1985

Cadastral surveys deal with one of the oldest and most fundamental facets of human society — ownership of land.

They are the surveys that create, mark, define, retrace, or reestablish the boundaries and subdivisions of the public lands of the United States.

They are not like scientific surveys of an informative character, which may be amended due to the availability of additional information or because of changes in conditions or standards of accuracy.

Although cadastral surveys employ scientific methods and precise measurement, they are based upon law not upon science.

Cadastral surveys cannot be repudiated, altered, ignored, or corrected; the boundaries created or reestablished by them are unchangeable so long as they control rights vested in the lands affected.

In fact, cadastral surveys are the foundation upon which rest title to all land that is now, or was once, part of the Public Domain of the United States.

This issue of *Your Public Lands* salutes the past and present surveyors of the Bureau of Land Management on the occasion of the 200th anniversary of the Public Land Survey System.

Equipment used by this 1920's survey crew was a great improvement over that used by the Nation's first surveyors. But this was hardly a beginning compared to the technology used by today's surveyors.

America's Land Surveying System Is 200 Years Old

By Charlie Most

In narrowing sweeps, the helicopter coursed the barren shoulder of the arctic mountain. It steadied over a small area in the nearly featureless tundra landscape, then hovered motionless as a heavy, flag bearing aluminum monument dropped to mark precisely a specific ground location. Then the machine moved due north in search of another, otherwise featureless but specific location that it would also mark with space-age precision.

This helicopter and its crew are on a mission to survey Federal land in Alaska. Through the use of advanced technology, primarily a device called an auto-surveyor, the helicopter crew can determine its exact location once the device is set for a known reference point. Through a combination of gyroscopes, an acceleration measuring

instrument, and a specially designed computer, continuous readouts of the helicopter's latitude, longitude and elevation are given. After the flagged monument is dropped, a ground crew will move in and erect the monument permanently.

These are the Federal government's cadastral surveyors—the latest practitioners in a long line of professionals whose job has been the measuring and marking of America's land for 200 years.

Although surveying is an ancient art, probably dating back to when man first claimed a parcel of land, older surveying systems were not very accurate and often led to misunderstandings, arguments, and sometimes bloody feuds or wars.

But 200 years ago, that renaissance man of America's Revolution, Thomas Jefferson, felt there had to be a better way for determining and marking land boundaries. When the Revolutionary War ended, our new government—lands that would bring much needed revenue and also help pay our soldiers and sailors for their long years of sacrifice.

As chairman of a committee seeking ways for identifying these lands for future settlement, Jefferson insisted on an unambiguous and logical system of land surveying. He looked to New England for a model.

In the New England colonies, most land was surveyed in rectangular townships. From experience, the New Englanders found that a township six miles square worked best. With church, school, and town hall placed an equal distance from any boundary, everyone in the township was within about three miles of its center. Jefferson, however, advocated the use of the metric system so he recommended 10-mile-square townships. Satisfied with their own experience and preferring the English method of counting by multiples of 12, the

Thomas Jefferson played the major role in developing the public land survey system. The results would have been a surprise to even this farsighted renaissance man of America's past.

Republic was deeply in debt to France, to wealthy citizens who had risked much in support of the cause, and to the soldiers who had fought for our freedom.

There was no ready source of revenue to support a new government, but there was land. Just beyond the Appalachian Mountains, in Ohio and beyond, were millions of acres claimed by some of the original colonies. These colonies were persuaded to cede their western holdings to the central

New Englanders prevailed and the six-mile-square townships were adopted.

Thus Jefferson, New England and the Nation all won. Jefferson won his principle of rectangular survey, New England won on its insistence for a crucial detail, and the Nation gained a simple, logical surveying system.

The resulting Land Ordinance of 1785 became law on May 20 of that year, 200 years ago. Based on what is known as the rectangular system of surveying, its effect on the ownership of almost anything related to the land—farms, forests, minerals, parks, private homes, factories, railroads, and whatever—has been mind boggling. Yet, like most truly effective procedures, the Public Land Survey System is simple.

First, an Initial Point is determined for the area to be surveyed. From that point, an east-west line, known as a baseline, is run and marked in six-mile segments (with each mile also marked). Another line, called a Principal Meridian with a specific number or name, is run north and south of the initial point and is marked at six-mile intervals (with each mile also marked).

More lines are then run north and south from the six-mile monuments, known as township corners, on the baseline and east and west from the six-mile monuments along the principal meridian to form a grid of six-mile squares around the initial point.

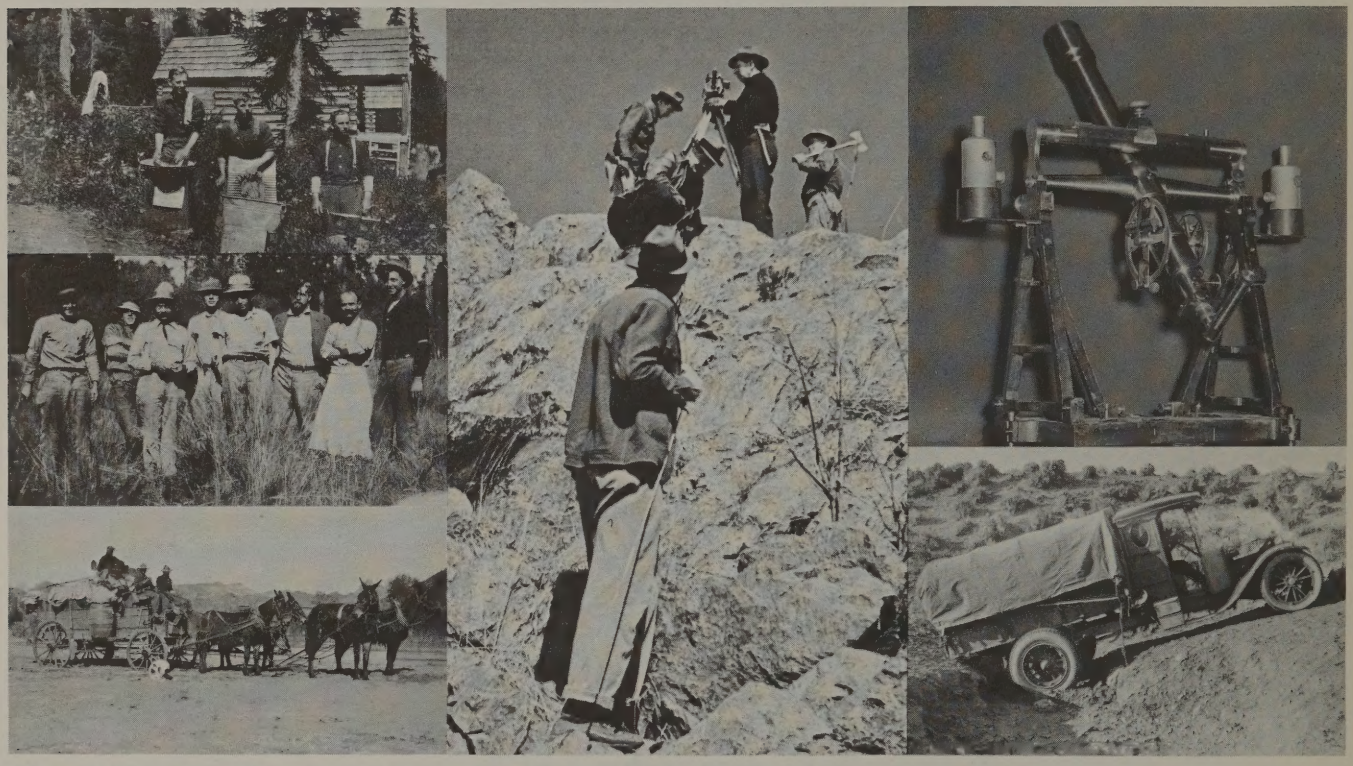
These squares are designated by their number north or south of the baseline (called "townships"), and east or west of the principal meridian (called "ranges"). For example, if a square is the third one north of the baseline and the third one west of the principal meridian, it would be designated as "Township 3 North, Range 3 West" or T.3 N., R.3 W., followed by the name or number of the specific principal meridian.

Each six-mile square is further divided into 36 smaller squares of one mile to the side, called sections, and each of these is assigned a specific number. Section 1 is in the northeast corner with sections being numbered sequentially to the west to Section 6. Section 7 is immediately south of Section 6 and then sequentially numbered back to the east until Section 12 is reached, and then similarly back and forth to Section 36 which is in the southeast corner.

Sections may also be divided into smaller, equal parts and described according to their location in that section. A 40-acre tract just north and west of the center of the section would be called the southeast ¼ of the northwest ¼, followed by the section number.

The result is a precise description for almost any segment of land anywhere in the United States where surveys have been completed. Such a description for a 40-acre tract in central Idaho might read: SE ¼ NW ¼, Sec. 12, T.3 E, R.2 N., Boise Principal Meridian.

All of this surveying and land



"Only the rugged need apply." Early day surveyers had to be tough since the work was physically demanding and social amenities almost non-existent.

marking had to start somewhere and that specific place, located on the north side of the Ohio River near East Liverpool, Ohio, is known as the Point of Beginning. There, on September 30, 1785, a group of surveyors braved what was then a wilderness to carry out the first public land survey under the very real threat of Indian attacks, the difficulties of running straight lines through dense timber and brush, and encounters with wild animals.

Despite the real and imagined dangers and hardships, as well as the crude instruments used, these first public land surveyors completed work on 800,000 acres in about 14 months. Since then, some billion and a half acres of land, or more than 60 percent of America's land mass, have been surveyed into a grid that blankets 30 of the 50 States.

And, unlike most previous efforts to settle unclaimed lands elsewhere, our system was geared to identification of lands before they were to be settled. This principle of surveying the land before patenting is unique to the United States.

Much of this land was sold into private ownership during the early days of our Nation. Other lands were later offered to homesteaders to encourage settlement, given to railroads for establishment of a national transportation system, designated as national forests, parks, and wildlife refuges, given to States in support of a public school system, and used to establish and support the land grant colleges or State universities in most States.

Much of the original surveying work has been done but the monuments used in those days were wood posts, carved rocks, pits or other materials that could not weather the decades and centuries since. As a result, much work is being done to remonument by resurvey of the original surveys.

Modern surveyors have found that their predecessors were meticulous men, carefully running their survey lines and establishing corner monuments with rather primitive equipment. It takes detective work on occasion to find the remaining evidence of where they are supposed to be, but for the most part, the original survey notes and the indications of where a monument was placed are very accurate. The new monuments are almost always placed right where the old ones were. Otherwise, chaos would be inevitable.

In addition to the continuing

Transportation was a major problem, primitive camps were the norm, and instruments, though quite accurate, were very slow.

remonumenting effort, the Federal government's cadastral surveyors are also involved in several special projects. These include original surveys of certain portions of the Navajo Indian Reservation in Arizona and survey work on Indian reservations in Maine, Minnesota, and Florida, and a complete resurvey of approximately 9,000 square miles along the Front Range in Colorado where tremendous growth in recent decades has clouded many land ownerships and boundaries.

Today, the biggest project of all is the original surveying of Alaska in order to identify lands to be conveyed to the State or to Native Corporations under Federal law.

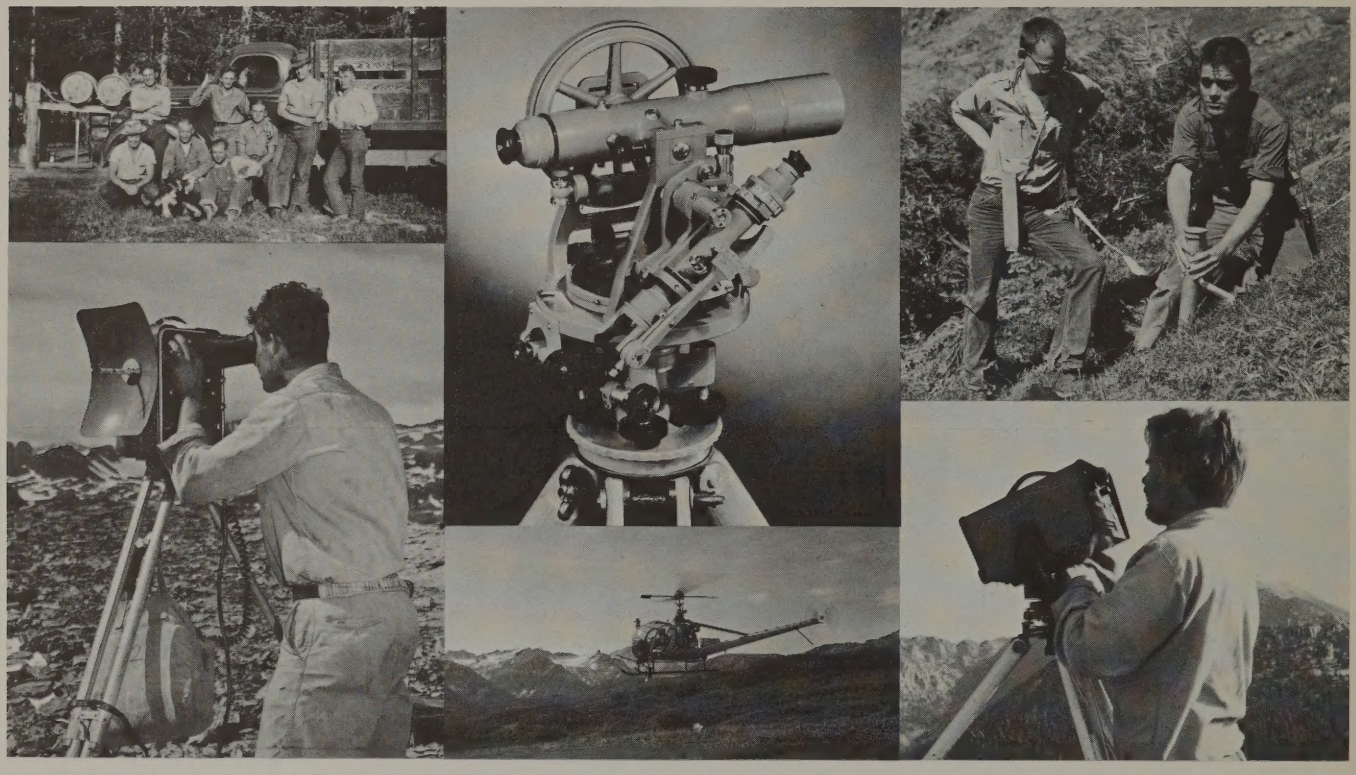
With laser beams and microwave instruments for measuring distances, determining precise locations via satellite contact and the auto-surveyor, and with other space-age technology, modern surveyors are able to work much faster and with far greater accuracy than did their predecessors a century or more ago.

Our country's pattern of growth can be traced from the land surveyors who drew the "blueprints" for America's orderly expansion and settlement. Originally, the surveyors were part of the State Department and then the Treasury Department. When the Department of the Interior was formed in 1849, the General Land Office, including the Surveyor General, became a major responsibility. It remains so today, exercised through the Bureau of Land Management since its creation in 1946.

The Bureau of Land Management carefully guards the plats and field notes of all public land surveys. They are still the daily working papers not only for government surveyors but also for private surveyors in the 30 States that have been surveyed in this rectangular manner.

The Bureau's surveyors are responsible for defending all 200 years of survey evidence when litigation is necessary.

These public land surveys and records played an important role in America's history, a role that continues to be vitally important today as well as into the foreseeable future. And it all started 200 years ago with a Land Ordinance that helped underwrite our country's infancy and then nurture its growth into the orderly pattern of land uses all of us now take for granted.



Improvements in equipment and technology continued at a rapid pace, and these advances dramatically speeded up the surveying process.

Charlie Most is Chief, Branch of Resource Information, in the Bureau of Land Management's Office of Public Affairs in Washington, D.C.

Land Surveying Still Has Its Challenges

By Charlie Most

Among the challenges facing today's surveyors is to measure the Sprawling Navajo Indian Reservation in northeastern Arizona.

Throughout its long and illustrious history, the Public Lands Survey System has met many challenges. But challenges are hardly a thing of history books because today's cadastral surveyors also have their own challenges to meet. Several special and complex surveying projects are currently under way in the United States in addition to the nearly continuous remonumenting of older surveys.

One of the largest unsurveyed land areas in the Lower 48 is the sprawling Navajo Indian Reservation which lies mostly in Arizona but also extends into New Mexico and Utah. It has to be surveyed. The question could well be asked, "Why survey an area that's never needed it before?" The answer is minerals—coal, uranium, oil and gas—and development for commercial and residential uses that cannot be developed without accurate land descriptions.

The Navajos would like to be able to lease these minerals as one way to bring in industry and related jobs, boost the tribal economy through lease sales, and improve the quality of life for the Navajo people. So the Bureau of Land Management, as the Federal government's official surveying agency, fielded a team of surveying experts who have been working in cooperation with the Navajo tribal government and the Bureau of Indian Affairs.

The Navajo reservation covers nearly 25,000 square miles, yet its energy resources are so widespread that about 20,000 square miles will have to be surveyed. This is hardly an easy undertaking, since the terrain and isolation add their own share of difficulties to an already knotty surveying situation. It's a harsh, rugged land, hot enough in the summer to practically blister the rocks, and it's periodically swept during the winter by terrible blizzards that often require rescue efforts for tribal members marooned in remote areas.

"A job of this magnitude takes time and patience," says James P. Kelley, BLM's cadastral survey chief for Arizona. "The current surveying project started three years ago and three to four survey crews have completed original surveys of township and section corners on 26 townships. Another 900 townships remain to be surveyed and the job could well take 20 to 25 years," Kelley added.

The tribe has placed the highest surveying priority in those areas of known energy resources. Surveys will establish boundaries for determining lease areas to avoid risking overlapping leases that could result in lawsuits and other problems. Growth areas where new townsites are likely to develop are also targeted for early survey work. Other priorities include defining the boundaries for the tribe's 110 "chapters," or local government units, to help identify voting precincts and to more accurately census tribal members. Surveys are also needed for highway construction because a better transportation system is sorely needed on the reservation.

One of the survey crews working on the Navajo Reservation is led by Jones Curtiss, a Navajo who graduated from Peninsula College in California. Six other Navajo surveyors are being trained while serving on crews led by BLM supervisory surveyors.

Other Indian tribes are also benefiting from the work of BLM's cadastral surveyors. Near Old Town, Maine, surveying is moving ahead under the Maine Land Claim Settlement Act which, in 1980, called for the use of Federal funds to acquire land for the Passamaquoddy tribe.

Tracts of land are being bought for the Passamaquoddies but the legal boundaries of some of them are known from just drawings on paper. Mike Avery, who heads up the Passamaquoddy surveying project, says it's like "retracing a ghost. Some of these old land records go all the way back to purchases in England well before the Revolutionary War."

One of the most physically and mentally difficult surveying projects in recent years involved establishing corners and boundaries for the Makosuki Indians in the vast, waterlogged everglades country of south Florida. The Makosuki tribe received land through a complex arrangement where land originally deeded to the State of Florida was in turn deeded back to the United States to be held in trust for use by the Makosukis.

It all started in 1850 when the Swampland Act was passed. Under that Act, a large block of the everglades country south of Lake Okeechobee was deeded to the State of Florida, and this transfer is often referred to as "the Everglades Patent." The western boundary of this tract has been officially surveyed in part and also surveys had been made along the eastern boundary in the vicinity of Miami.

Florida drew up its own surveying procedure in 1918 and hired a private surveyor to use this procedure in surveying the Everglades Patent. Although the approach was similar, the land was not surveyed according to the Public Land Survey System. When Florida reconveyed some of this land to the Federal government for use by the Makosuki Tribe, an official, legal survey had to be made of the new Tribal lands.

The west boundary for the new reservation was the same as the partially surveyed west boundary for the Everglades Patent. When the surveying crew started running the north/south line, they found that one six-mile range had been surveyed but that the next one had not. Then, they found another one that had been surveyed.

Field work on the Makosuki survey was completed a year ago and the last land plats for it were drawn in February of 1985. But it was far from an easy task in more ways than one.

Although the surveying project, complicated by previous surveys and procedures, did present some opportunities for mental gymnastics, that wasn't the only mental difficulty involved. There was also the apprehension of working, often in waist-deep water, where snakes, including the poisonous cottonmouth moccasion, and alligators were far too common for peace of mind.

Corky Rodine, supervisory surveyor on the Makosuki project, relates how the survey team's truck broke down one evening and the men had to walk in the mosquito-infested darkness for more than eight miles through a marsh that had "gators rumbling away on all sides."

The survey crew lived in a converted bus during the project but they didn't like to use the shower it provided. They preferred to bathe in a nearby drainage canal, and Rodine said it was "very interesting" to bathe while alligators formed a curious circle around them, sometimes only a few feet away.

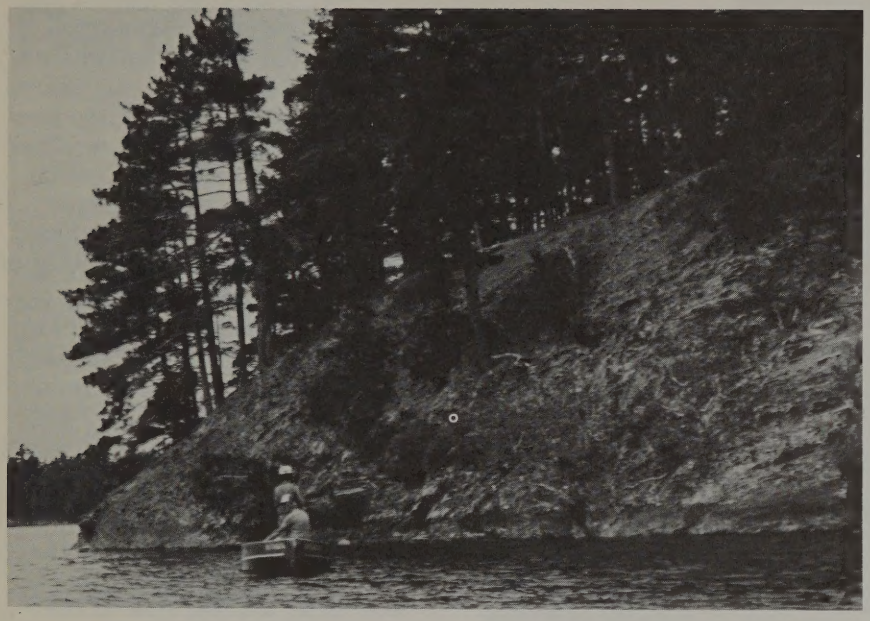
On another occasion, they were using a small, full-tracked vehicle to work some particularly marshy areas and the starter for the vehicle refused to work when it was time to return to camp. This walk was only three miles and they walked back the next morning with tools and parts to repair the vehicle. Rodine said he was underneath it with only a four-inch breathing space between the bottom of the vehicle and the surface of the water, "and it was dark under there."

While trying to keep his mouth above water, remove a metal plate covering the starter, and ignore his crew who kept talking about snakes, Rodine felt something slippery moving along his chest. " I lifted that vehicle to get out of there," he said. Although the "snake" was only a piece of wood made smooth and slippery by the water, the constant idea of stumbling onto a poisonous cottonmouth hardly added to the composure of the crew.

But there were other adventures that were exciting without danger. The Everglades have long held rumors or stories about a lost Spanish city. It was thought to be on one of the islands which in this portion of the Everglades are called "heads." One day the surveying crew ran their line across a head where there were broken pottery, rusty cannonballs, and apparently the largest royal poinsettia tree ever known, a beautiful, flowering tree that was 70 inches in diameter!

During the early days of western settlement, mountainous areas were often bypassed by the Federal surveyors, who were told to concentrate on lands that would be more suitable for settlement. The gold rush days of California, Idaho, Nevada and Colorado changed that. Surveys of mountainous areas, particularly where mineral resources were important, soon started.

One of the key areas was along



Land to be acquired for Maine's Passamaquoddy Indians under the Maine Land Claim Settlement Act had to be surveyed first. The many lakes and islands involved made the job more difficult.

the Front Range of the Colorado Rockies. These are the first mountains seen from the plains on approaching from the east. Eldora, Central City whose Glory Hole mine made it the "richest square mile" on earth, Silver Plume, the vastly rich Cripple Creek mines behind Pikes Peak, Victor, and other famous camps sprang up in these mountains, while other important but not so well-known mining camps came into being farther south. Many of these southern mines were for coal to be used in smelting the gold and silver ores from the more northern mines.

Because paying strikes on the public lands can be deeded to individuals, surveys were needed for legal recordation to prevent mining wars or at least legal squabbles. A U.S. Mineral Survey must be approved prior to a patent being issued for a mining claim.

In 1869, government surveyors took to the foothills and peaks of the Front Range to mark this rich bonanza region. The mining camps have long since given up most of their mineral wealth but this land is still valuable today because of the burgeoning population in the Denver and Colorado Springs area.

Land in the nearby mountains has become prime real estate, but there is some confusion over intermingled ownerships. The public lands here are in scattered fragments due primarily to the unique pattern of old mineral claims and patents which followed the ore veins or streams. Some are worth thousands of dollars an acre. How can such lands be managed or sold for the public's benefit without accurate, legal descriptions and on-the-ground markers? Many of the old surveying monuments were just pine posts that have long since rotted away.

During the summer of 1979, a complete resurvey of the Front Range from north of Fort Collins to south of Walsenburg was launched. The magnitude of this project, involving 260 townships or approximately 9,000 square miles, is such that completing it may take 20 years or more. Complicating the procedure will be the thousands of mining claims that need to be researched, a process of going through courthouse and other land records to verify who has what.

Ken Witt, chief of BLM's cadastral program for Colorado, says there's a strong likelihood of finding hundreds of cases where people have built on or are occupying the wrong land, or where two mining claims cover the same spot. "But unscrambling all this will result in better resource planning and management for the Federal lands. And counties, the State, and individuals will at least know where they stand as far as land holdings are concerned," Witt added.

Although modern surveying techniques are more accurate than those used in 1869, the original survey monuments remain the legal basis for surface ownership. To change survey corners or boundary markings every time more accurate equipment comes into use would not only break long-standing legal precedent, but would also create continuing chaos. The Front Range project then is basically one of remonumenting the old survey by the resurvey process, and that calls for detective-like work.

Using field notes written by the original surveyors, today's survey crews are rerunning the old lines and then reestablishing the corner monuments. But quite often, those monuments no longer exist. When a resurvey indicates where such a monument was originally placed, digging, to see if there is any discolored dirt from the rotted wood of an old wooden post monument or rusted iron from a metal monument, may prove the actual location. Sometimes, nothing is found and running survey lines to the location from previously located corners, or talking to longtime residents who may recall where the monument was, provides the answer.

Of course, the old-time surveyors

The Marshy Everglades country of south Florida Brought new problems, including mosquitos, snakes and alligators.

often trudged up the mountain ridges with heavy support equipment while conducting their surveys, but today's surveyors can usually call on a helicopter to take them and their lighter gear quickly over rough country. But surveying in the high country is primarily a summertime thing; the snows of winter usually bring a halt to such work. Some winter days may be sunny and warm enough to work the southern slopes where snow cover has melted, but most of the winter work concentrates on checking old land records to determine valid ownerships and their location.

When the basic net of section lines is eventually determined and the corners marked, the actual boundaries of mineral patents, homesteads, and other ownerships can be located on the ground and on the land record maps.

The helicopter has become almost a basic tool for cadastral surveyors working on one of the most massive survey projects ever undertaken. As a result of the Alaska Statehood Act which gave Federal lands to the State, the Alaska Native Claims Settlement Act which gave other lands to native tribes or "corporations," and the Alaska National Interest Lands Conservation Act which created new national forests, national parks and national wildlife refuges, more than 300 million acres of the "Great Land" needed to be surveyed. Last year, 24 survey crews were at work in places ranging from Ketchikan in the southeastern "panhandle" to Point Hope on the Arctic Coast and from Nome on the Bering Sea to Slana near the Canadian border.

The job is so big that more efficient methods had to be devised to get it done in any reasonable time. Through a combination of organization, teamwork and technology, great strides are being made towards completion of this huge project. First of all, crew areas are assigned and housing and equipment needs are determined. These supplies are then flown into some of the most remote sites in the United States.

The technology is in the form of advanced surveying instruments such as the auto-surveyor. This is actually a collection of instruments that includes a gyroscope, an acceleration measuring device, and two computers. When accurately set for a known site, the auto-surveyor will then give out accurate location readings regardless of how or where it is moved.

A helicopter is the normal vehicle for the auto-surveyor. Once calibrated to a specific site on the ground, the helicopter can then be flown along directional lines, stopping at intervals to allow recalibration of its auto-surveyor, until it hovers precisely above a point where a survey monument should be located. A marker is dropped to pinpoint the site and then a ground crew will come in and place a permanent cadastral survey monument.

With these techniques, the cadastral surveying teams in Alaska have now surveyed more than 75 million acres, despite the near continuous assault of mosquitos, the chances of meeting a grizzly bear that might challenge the right-of-way, or an aroused cow moose bent on defending her calf.

And such dangers or nuisances are all too real. In fact, on July 25, 1985, members of a BLM surveying crew near Lake Iliamna on the Alaska Peninsula were returning to their helicopter when they accidentally came onto a grizzly bear with three cubs. The mother bear attacked and severely mauled two survey crew members before being killed with a rifle by the survey party chief. The two injured surveyors were immediately flown to a hospital in Anchorage.

The old-time surveyors had it pretty rough, often facing life threatening situations from hostile Indians, weather and rough terrain. But there's still enough excitement to go around in today's survey work. Whether climbing up a windswept ridge in the Colorado Rockies, watching for flashfloods in Navajoland, or keeping a wary eye on a lumbering grizzly in Alaska's bush, today's surveyors emulate their predecessors—they do the job under conditions likely to be uncomfortable at best or, in some cases, even dangerous.

Charlie Most is Chief, Branch of Resource Information, in the Bureau of Land Management's Office of Public Affairs in Washington, D.C.

Reuben Oldland: A Settler's Story

Reuben Oldland's story is one of many about pioneers who settled America's public lands. It's a story of great sacrifice as well as opportunity: it's a family story, one of a million in the 200 years of survey and settlement of our Nation's public domain.

By Hans Stuart

Wood corrals are still the hallmark of ranchers along Piceance Creek near Meeker, Colorado. Here, Reuben Oldland and three partners founded the Spur Ranch in 1885.

In the winter of 1890 Reuben Oldland lost almost everything. The snows began in October, as did the cold weather. By January his cattle could no longer dig down to the grass on their winter range along Piceance Creek in northwest Colorado.

"It was almost more than he could bear, with all those cattle bawling outside," recalls his grandson Reuben. "By the time it was over, people said you could walk from White River City to Meeker without touching the ground, there were so many dead cattle."

None of the homesteaders along the creek had stored any hay, for the winters had never been this severe. The ranchers, in fact, faced a battle for their own survival. Many of the newer homesteaders spent the winter in tents or makeshift caves. Oldland and his family lived in a cabin he built two years before.

By the time spring arrived, Reuben had lost all of his prized longhorns. Most settlers abandoned the area that year. He, too, had to decide his future.

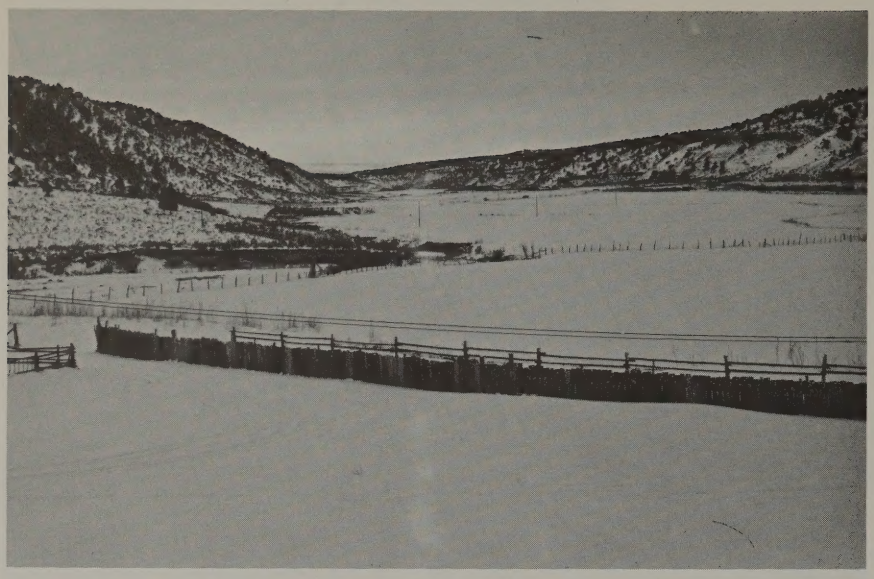
Reuben Oldland's story is one of many about pioneers who settled America's public lands. It's a story of great sacrifice as well as opportunity: it's a family's story, one of a million in the 200 years of survey and settlement of our Nation's public domain.

The Land Ordinance of 1785 is a good place to start Oldland's story. Not only did it revolutionize the art of surveying, it created opportunity for the common man to own land in this country. It established a Public Land Survey System used to describe and subdivide more than 1.8 *billion* acres of lands in 32 States, of which 1.1 billion acres were transferred out of Federal ownership. Over 278 million acres of land were patented under the Homestead laws, including 160 acres to Reuben Oldland.

Hammered out of passionate debates in the Continental Congress, the Ordinance determined how the Nation would settle and defend its new borders, finance the government, and pay the soldiers who fought for its freedom.

Delegates to the Congress also had to decide *what* kind of survey system should be used for the Nation's public lands, *who* would do it, and *how* the lands should be sold or granted. Speaking for the small farmer, a surveyor named Thomas Jefferson argued that an essential part of a democracy was the right to own property—he favored a rectangular survey system with direct sales of small parcels to citizens.

Most of Jefferson's recommendations were adopted, over the opposition of Alexander Hamilton and other large land owners, who believed that only land companies or private organizations could handle the problems of surveying, patenting, and defending the frontier. But responsibilities for doing the work were placed in the Treasury Department under Hamilton, its first Secretary.



The Ranch has haying lands in the Piceance Creek Valley and grazing lands along the surrounding hillsides.

The Land Ordinance of 1785 established six-mile-square townships that were alternately sold to companies or subdivided and sold to individuals. It also established the principle of survey *before* sale, which greatly reduced the property disputes found in earlier surveys. (Most were metes and bounds surveys—a first-come, first-served system in which property lines were run to and from natural features, such as trees and creeks.)

In addition to being quick and efficient, the rectangular surveys were quite accurate. In the fall of 1785, Thomas Hutchins, Geographer of the United States, joined eight State surveyors and a crew of 30 in Ohio to conduct the nation's first public land survey. In little more than a year, the Ohio surveys totaled 800,000 acres.

In only a hundred years the United States more than tripled its size, adding almost two billion acres to the public domain. Dividing and describing this land proved to be an enormous task. By 1885, more than two dozen points of beginning for Principal Meridians and baselines had been established in the rush to survey the public lands. The General Land Office, established in 1812, moved to the newly created Department of the Interior in 1849 to more efficiently survey and transfer the land.

Reuben Oldland was 30 years old in 1885, and had just settled on the Spur Ranch. He and three partners traveled to Dodge City, Kansas, the previous year to purchase 1,000 head of cattle, 30 bulls, a mess wagon, and the rights to the Spur brand. After an arduous trip across the plains that summer, Oldland was surprised to find settlers on the land he selected for a ranch on an earlier visit to the area. "There were so many settlers, Rube and his friends had to drive the cattle 35 miles up Piceance Creek from the White River," recalls his grandson, who lives on the ranch today.

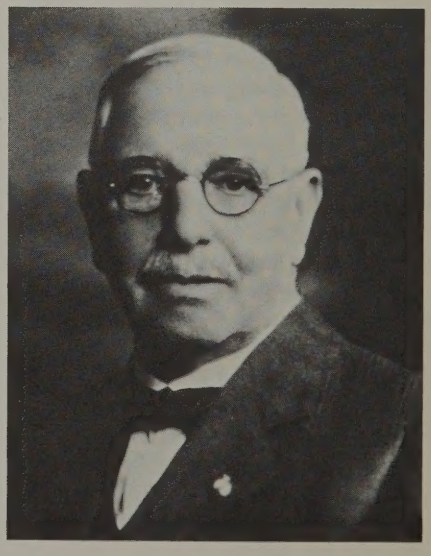
Only 30 years earlier—in the year Oldland was born—the General Land Office began a survey of the Kansas-Nebraska boundary, whose baseline was eventually used to survey the land around his ranch in Township 3 South, Range 96 West. The Sixth Principal Meridian was established west of the Missouri River on the 40th parallel, and the baseline marked for 108 miles west that year. By 1858, it extended to the Rocky Mountains.

Most public land surveys east of the Mississippi had been completed in the 1850s, as well as in Missouri and Iowa. Surveys had also begun in New Mexico, Utah, and on the West Coast.

In 1869, at the age of 14, Oldland left his father's small farm in Bristol, England, to meet his brother Will in Pennsylvania. It was the same year the transcontinental railroad was completed, and only seven years after the Homestead Act was enacted.

Hearing of gold in Leadville, Reuben arrived in Colorado in 1878. A year later he managed the Kitty Hawk mine. It was there he met his wife, Sarah Jones, and three Irish friends who would become partners at the Spur Ranch.

The next year was pivotal: miners struck all the mines in Colorado, and they remained closed



Reuben Oldland's hard work and personal integrity made him a successful rancher and businessman in the Meeker, Colorado area.

Spur Ranch is very much a working cattle operation. Here, Reuben Oldland, grandson of the Ranch's founder, riding Badger, and Dick Collins on Playboy move cattle to a different pasture.

for several years. Reuben traveled through the White River Valley for the first time, describing it to his grandson as "having grass so tall a man riding on horseback couldn't be seen."

That was also the year Nathan Meeker headed the White River Agency, created to "civilize" the Ute Indians in western Colorado. Meeker decided the Indians should learn to farm, and when he plowed up a track where they raced horses, it became the year of the Meeker massacre. Within two years, the Utes were moved to a reservation farther west and their lands opened for settlement by Congress.

So, only a hundred years after the Land Ordinance of 1785 was adopted, surveyors had reached the former Ute lands. The Glenwood Springs land office of the GLO opened in November 1884, and had received 313 filings for homestead entries on 5,222 acres of those lands.

The year 1885 is a significant landmark in several respects. In the 100 years since the Land Ordinance was enacted, more than a billion acres of the public domain had already been surveyed nationwide. More than 700 million acres had been transferred out of Federal ownership, including 200 million acres to individual settlers.

During fiscal year 1885, the General Land Office reported its surveys totaled more than 30 million acres, including 3,368,340 acres ("10,650 miles, 29 chains, and 27 links") in Colorado. By this time, 57 million acres of public domain in Colorado had been surveyed and settled, with only 9 million acres unsurveyed.

Surveyors still marked off lands with the 100-link chains called for in the Ordinance of 1785. At 66 feet each, it took 80 chains to measure a mile. By this time, compassmen were using solar compasses to improve the accuracy of magnetic needles. In western Colorado, township and section corners were chiseled into stones.

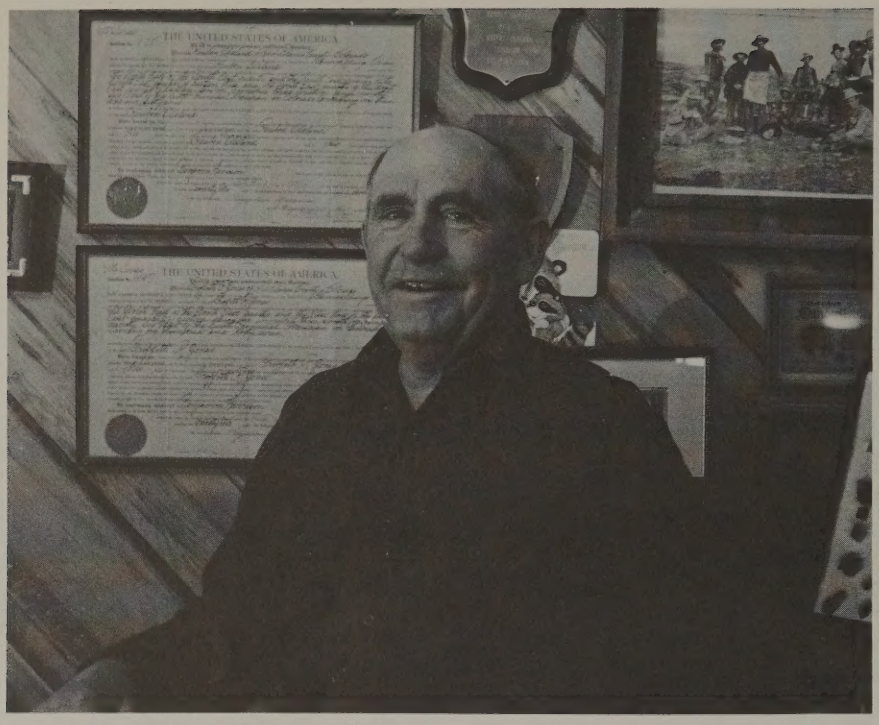
1885 was also a point of beginning for land reform. GLO Commissioner William A. J. Sparks suspended land entries on most of the public domain (except the Ute Indian lands) to investigate widespread land fraud.

Citing "fraud, favoritism, and fees," Sparks recommended land disposal actions be made only to individual homesteaders. The issue of fraudulent surveys and patents was not resolved for several years. In 1886 N. H. Meldrum, the Surveyor-General for Colorado, suggested that U.S. Geological Survey employees be used to execute rectangular surveys at the same time they did topographic mapping. However, the suggestion for employing full-time government surveyors was not adopted until 1908.

After founding the Spur Ranch, Reuben and Sarah moved to Glenwood Springs, where he served as Clerk and Recorder of Garfield County (the northern part became Rio Blanco County in 1889, with Meeker as the county seat). His partners stayed on the ranch until Reuben and Sarah moved back in 1888 and filed a homestead entry for the land. While he was in Glenwood Springs, Reuben was reunited with his brother Ambrose, who also decided to stay and settle in Colorado.

By 1888 the GLO contracted for a survey of the exterior and subdivisional lines of Township 3 South, Range 96 West of the Sixth Principal Meridian, where the Spur Ranch is located. Deputy Surveyor Francis P. Monroe's field notes reported that the township was "well watered by the Piceance creek in the N.E. portion and the Stuart gulch and its branches in the middle of the township. These branches carry water or have good springs at short intervals. Several settlers are located along these gulches and the Piceance . . . there is an abundance of red spruce, pinon, and cedar lumber principally in the western part of the township."

On August 30, 1888, his crew of two chainmen, a compassman, and an axeman noted that "R. Oldland's fence courses N. 70 degrees



The wall in Reuben Oldland's Spur Ranch office is covered with mementos that include the original Ranch Homestead Certificates awarded to his grandfather.

W." at 70 chains, 30 links from the east corner of Sections 3 and 10. When the survey was completed, Reuben filed for an entry of 160 acres under the Homestead Act.

With the terrible winter of 1890 only two years behind him, Oldland decided to stay on the Spur Ranch. In 1892 he patented his entry. Having lost almost their entire savings, Reuben, Sarah, and their four children worked for many years to restock the ranch. In addition to cattle, they raised horses (horses brought about $40 each vs. $30 for thousand-pound longhorns). His brother Ambrose moved the family store to Meeker, where it does business today (the Grazing Service and then the BLM occupied the second floor of the Oldland building for 25 years, until the mid-1960s).

Reuben moved to Meeker in 1904, helping establish the First National Bank. In 1928 he was elected to the Colorado Senate, where he helped enact the Rees-Oldland Bill—a State precursor of the Taylor Grazing Act, which established prior use of grazing lands in Colorado to settle disputes between ranchers and sheepmen. During the Depression, when other banks failed, Oldland used his own savings to keep the bank solvent. But once again his family had to start over.

Also in the 1930s, GLO surveyors conducted a dependent resurvey of Township 3S, 96W, replacing the original stone corner markers with brass caps. By this time surveyors had replaced chains with steel tape, and the magnetic and solar compasses with transits, but still calculated distances in links and chains, as they do today.

Reuben's sons Gerald and Walter chose to stay on the ranch, over other options given them by their father, and saw it grow to 8,000 deeded acres (with 1,300 cattle). The descendants of only two other original settlers remain along the Piceance. The 50-mile-long creek now supports only 12 ranches, compared to a hundred in the early days.

Reuben Oldland—"Rio Blanco County's most loved citizen," according to the Meeker *Herald*—died a year before passage of the Taylor Grazing Act in 1934. His grandson Reuben, now 67, is the second generation of Oldlands to grow up on the ranch. Marrying and settling there in 1949, he recalls that "it was a lot of hard work back then—but we worked together as a family, just as we do today." In addition to his wife Norma, their two children also live on the ranch with their spouses and children, thanks to the legacy of Reuben Oldland.

In 1946, the General Land Office merged with the U.S. Grazing Service to form today's Bureau of Land Management. BLM cadastral surveyors conducted a second dependent resurvey of the township in the 1960s, to subdivide it further and exactly define subsurface rights in the area. Much of the Spur Ranch is leased for oil shale development, as is the public land around it. While BLM cadastral surveyors still used brass caps to mark section and quarter-section corners, they replaced transits with today's extremely precise microwave- and laser-equipped instruments.

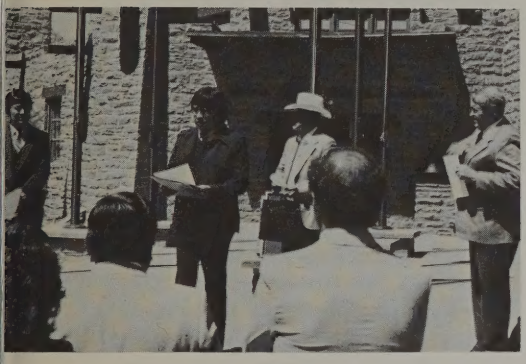
Winters are just as cold as they've always been along Piceance Creek (down to 50 below zero on a cold January night). Only now, the roads are paved and the property boundaries well established. The old cabin and pot-bellied stove are gone, but not the monuments left by the surveyors or the courage and persistence of settlers like the Oldlands.

Hans Stuart is a writer-editor with the Technology Transfer Staff at the Bureau of Land Management's Service Center in Denver.

1985: A Year Recognition for Cadastral Survey

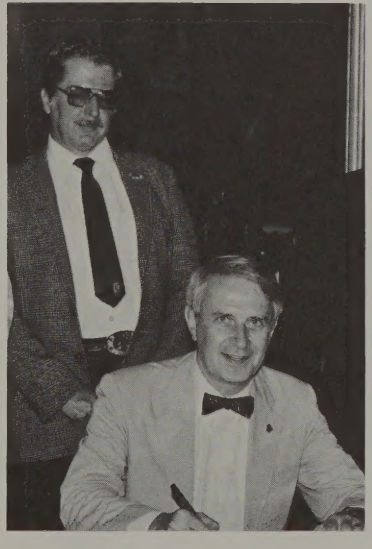
Virginia -- A direct descendant of surveyor Thomas Jefferson portrays his ancestor for members of the American Congress on surveying and mapping at a commemoration held on the lawn of Jefferson's Estate, Monticello, near Charlottesville.

Alaska -- Governor William Sheffield, right, receives a commemorative cadastral survey wall plaque from Mike Penfold, Alaska State Director of the Bureau of Land Management.



Arizona -- In Window Rock, Robert Burford, right, Director of the Bureau of Land Management, presented to the Navajo Tribal Council a plaque and a symbolic brass-cup monument like those being used to mark survey corners in the vast Navajo Reservation.

Oregon -- Bureau of Land Management State Director William G. Leavell, right, presents original 1868 survey map of the Oregon—Idaho border to Oregon State Lands Director ED Zajonc. Leavell presented a similar map of the Washington—Idaho line to the state of Washington.

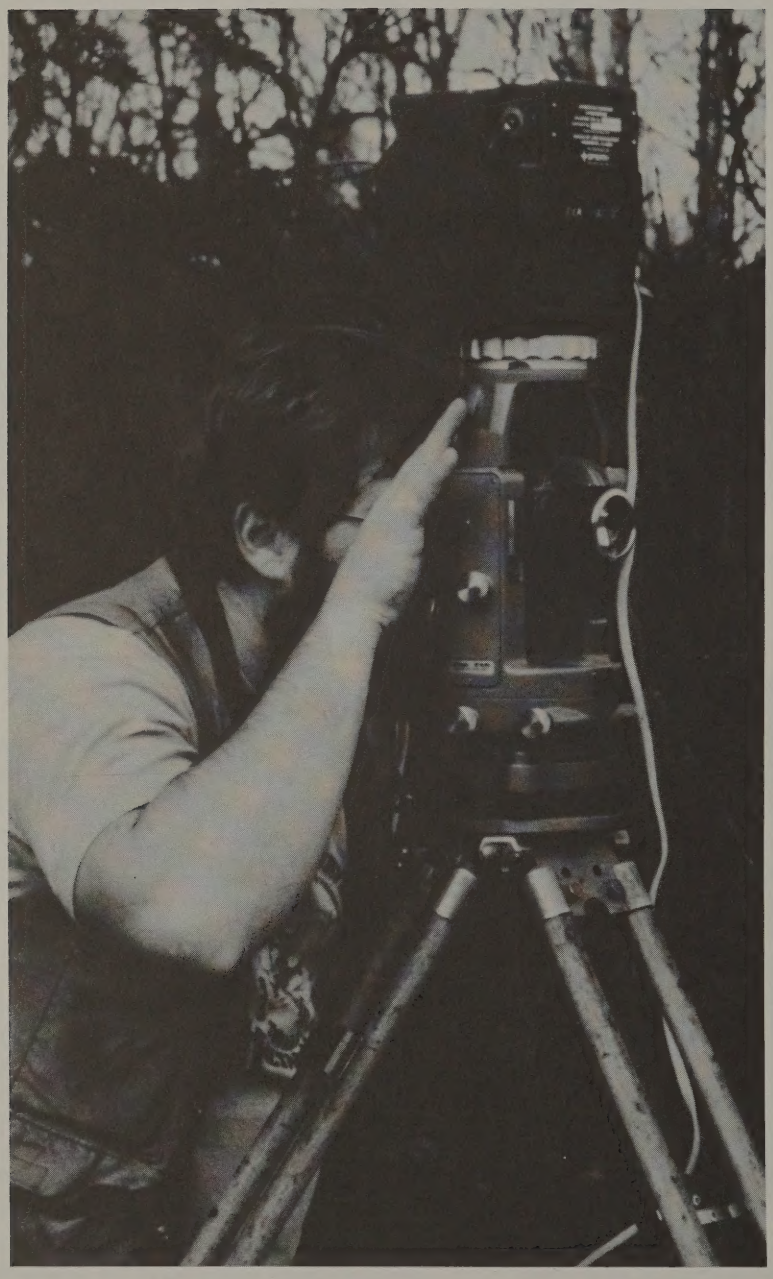


Wisconsin -- at a bicentennial commemoration, Wisconsin Governor Anthony Earl signs an Executive order creating a Wisconsin Land Records Committee. Among those looking on is Bernard W. Hostrop, center, chief, Division of Cadastral Survey, Bureau of Land Management.

Colorado -- Some 200 public and private land surveyors gathered at the Colorado Heritage Center in Denver to celebrate the 200th anniversary. Above is speaker Roger Patterson, president of the Professional Land Surveyors of Colorado, which co-sponsored the events with the Bureau of Land Management and the Colorado section of the American Congress on surveying and mapping.

Surveying in the 1980's: Plodding Becomes High-Tech Plotting

by Robert Johns

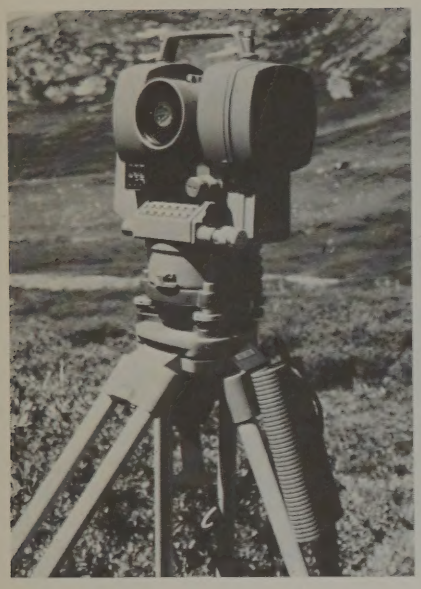


A surveyor sights through a theodolite -- An angle measuring instrument that is an improvement over the standard transit. On top of the theodolite is a north seeking gyro.

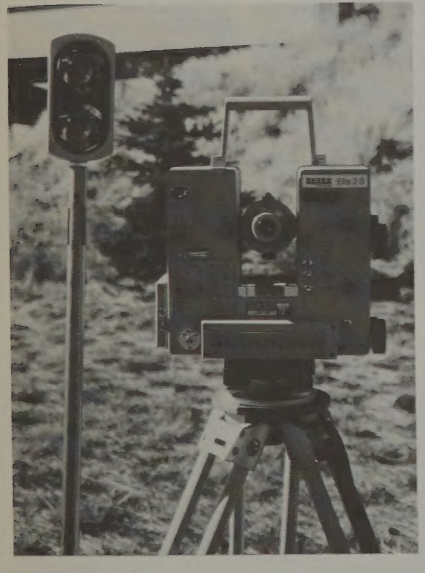
Laser beams, light waves, satellites, microwaves, photogrammetry and gyroscopic orientation are causing change in land surveying. Measuring tapes, compasses, and solar transits, while not yet considered as museum pieces, are beginning to collect dust on the shelf as new, more accurate, high-tech equipment brings exciting changes to an occupation dating back to biblical times.

Rather than loading up the horses and mules with equipment and life-sustaining provisions for month-long trips into desolate areas as was still done early in this century, today's surveyors load state-of-the-art equipment on jet-powered helicopters. They now do in days what formerly took months, and with greater accuracy, too.

A problem in early surveying times involved determining the direction of true north. When using compasses to determine direction, surveyors always had to keep in mind that the compass needle always pointed to the magnetic north, an area south and sometimes west or east of the north pole. But because the difference between true north and magnetic north was known, corrections



This is a "total station" because it measures both angles and distances. These instruments use infra-red rays or other sensing methods to determine distance between two points.



Another type of total station. On the left is the reflecting device that bounce beams or rays back to the primary instrument.

could be made. However, inaccurate readings caused by anomalies such as deposits of iron were more troublesome. Several large deposits of iron, however, were discovered by the erratic readings caused by magnetic compasses.

The shortcomings of the magnetic compass were overcome by a device called a solar compass. The solar compass was based on a principle astronomers and navigators have known and used for ages — the relationship between the sun and the earth. By using the solar compass and a publication known as the "ephemeris," which shows the daily and hourly declinations of the sun, the surveyor can determine directions and his location on any given day and hour.

Much like the magnetic compass gave way to the solar compass, now the solar compass has given way to several other measuring techniques and devices.

One system which is being increasingly used is based on data from orbiting satellites. Through this system, the latitude and longitude of electronic receiving devices on the ground can be determined based on signals generated by the satellite and through telemetric computations. The accuracy of the data is dependent upon the number of passes by the satellite used in the computations and by the angle of the satellite to the receiving station.

Once these selected reference points are established through satellite information, the distance to other points can be determined through the use of various electronic distance measuring devices and techniques. In many cases, distances can be determined using radio, laser and infrared beams which are directed to prism/reflectors located from a few feet to 80 miles away. The distance is computed automatically based on the time it takes the beam to return to the sending unit after striking the prism/reflector.

Once the distance between the survey points is determined, a device called a theodolite is used to measure the angle between the survey points and true north. When the angle and distance from the reference point are known, latitude and longitude can then be calculated.

These two measuring concepts, involving angle and distance measurements, have been combined in recent years into a unit referred to as a total station — a combined unit which reduces weight, setup time and costs, as well as providing automatic distance and angle measurements with increased efficiency.

Another type of surveying equipment, called an auto-surveyor, received its impetus for development as a result of surveying needs in Alaska. Congressional legislation granted more than 200 million acres of public domain land to the State of Alaska; to native Eskimos, Indians, and Aleuts; and for national parks, wildlife refuges, and national forests. Before any of this land could be transferred and titled, boundaries had to be surveyed and legal descriptions provided. It would have taken many years to complete surveys with ground crews, chains, and transits. So again, necessity proved to be the mother of invention. A new technique, adapted from the guidance systems used in airplanes and space vehicles, was developed for surveying needs.

The new system, using an auto-surveyor, establishes geographic positions by combining the principles of a gyroscope, an acceleration measuring device, and specially designed computers. A computer, which has been fed appropriate data about the starting location, records acceleration data and reactions of the gyroscope to horizontal and vertical movements of the helicopter in which the equipment is mounted. Data are then translated into distances and directions which tell the operator his exact location in terms of

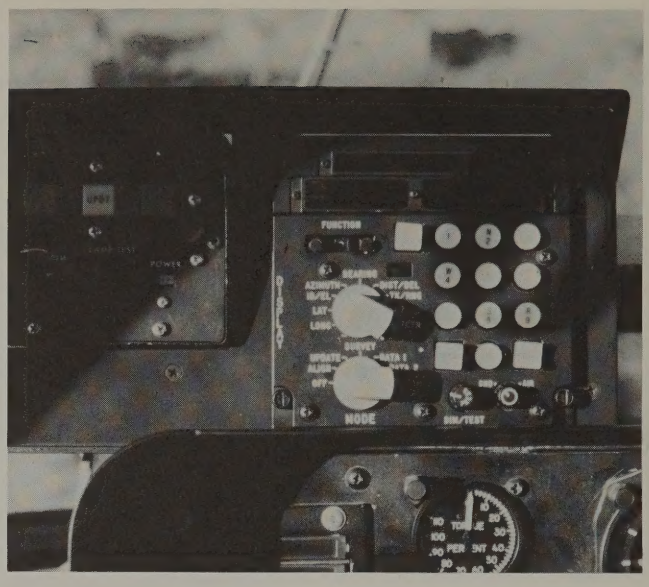
latitude and longitude. Once a corner placement is determined using this method, a fluorescent marker is dropped from the helicopter. Final placement of an official marker is made by ground crews.

The electronic field note book is another new product being tested that offers considerable promise. This recorder-like device collects and stores data from each day's surveying activities, which then can be fed into a computer and used to meet varying needs.

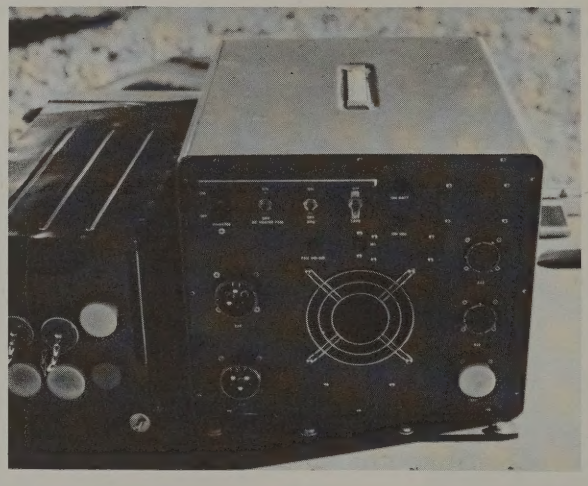
Even with all the new electronic, space-age technology, surveys still depend on the knowledge, experience, skill, and intuition of the people who are cadastral surveyors. At present, most of their work in the lower 48 states involves resurveys. These are necessary to reestablish corners that may have been lost or obliterated during the century or more since they were established. However, a survey must be tied to an existing corner. Study of original survey notes helps in the search for old survey monuments, such as wooden stakes or stones, and for bearing trees scribed to witness the corner location. Currently, stainless steel and aluminum posts with brass caps stamped with identifying numbers are used to mark survey corners in the rectangular survey system.

Surveys to delineate and describe the public domain, two-thirds of which passed into private ownership, shaped the pattern of America. The next time you're in an airplane flying across the Nation, you will realize that the neat pattern of squares and rectangles is attributable to the Land Ordinance of 1785 and to meticulous and persevering cadastral surveyors.

Robert Johns is Chief of the Office of Public Affairs in the Bureau of Land Management's Arizona State Office in Phoenix.



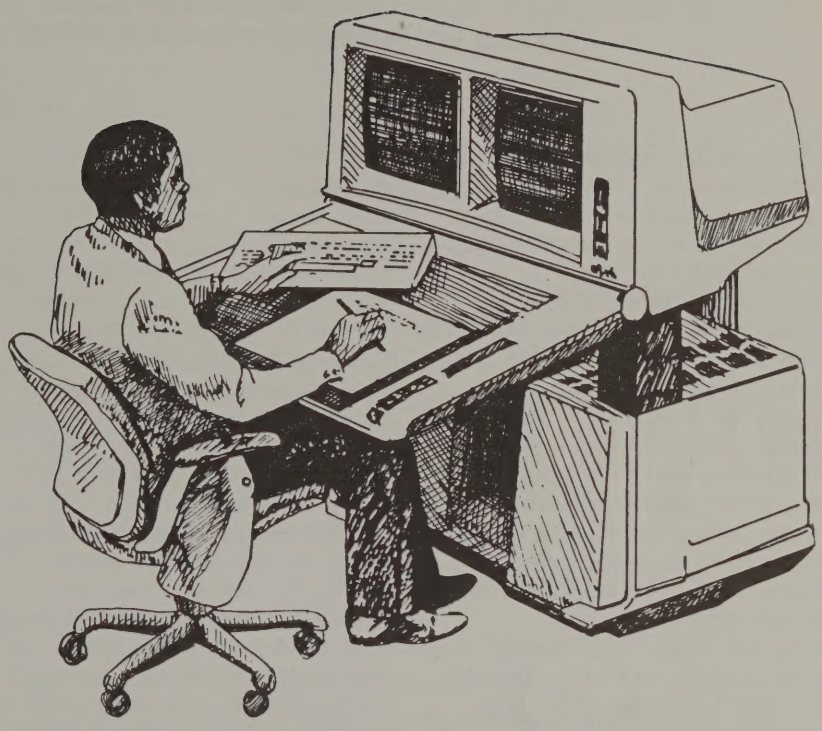
Helicopter-mounted auto surveyor.



Power supply and data storage components of the auto surveyor.

A total station for measuring both angle and distance between points.

BLM Automates



In the 220 Bureau of Land Management (BLM) offices, more than a billion ownership and use documents translate millions of acres into meaningful lands and mineral records. This takes volumes upon volumes of survey notes, plats, tract books, other papercopy records and microfilm technology.

. . . So, how does the Bureau access and manage all this data?

. . . And how do public land users currently get the information they need?

It now takes many people working many hours at tasks that are basically unchanged since the inauguration of the rectangular survey.

The Solution

This year, the 200th anniversary of the Public Land Survey System, marks the beginning of a change in the way BLM will handle public land and mineral records. BLM is developing an Automated Land and Mineral Record System (ALMRS) linking land description, ownership and use information together. Surveying equipment has evolved from the old 100-link chains to the precision of lasers. When ALMRS is implemented, land and mineral records will go from tract books to computer terminals. Automated systems will illustrate legal descriptions of all Federal lands, indicate ownership and status of all public parcels, provide pertinent regulations and laws, and enable users to read all stipulations restricting potential uses of land and mineral tracts. The system will be designed to illustrate graphically complex records on terminal screens or on charts and maps.

Manual lands records systems are being updated to assure accurate historical records.

When completed, ALMRS will combine a number of separate files and systems throughout the Federal Government to deliver a comprehensive and effective approach to maintaining public lands records. Users will be able to interact electronically with the system from remote locations. Terminals will be available at BLM State, District, and Area offices as well as through other local, State, and Federal agencies. Direct electronic access to land and mineral records will be available to the private sector as well.

Work on ALMRS is now underway. Several computer subsystems are now operational. BLM offices in New Mexico and Arizona have begun large-scale tests of computerizing existing land records.

ALMRS is a project whose time has come. It will help the Bureau by improving its efficiency and freeing personnel from much of the painstaking manual labor they now perform. It will help the public with faster, cheaper, and more accurate access to the public land records. Development and implementation of the Automated Land and Mineral Records System is foreseen as a major step towards better management of the public lands.

A concept document further explains the records and systems which are included in ALMRS. It is available to any interested public land user from: ALMRS Project Office, BLM Service Center, Denver Federal Center, P.O. Box 25047, Denver, CO 80225-0047, (303) 236-6507.

It's the Land Law

Survey corners are marked in various ways. Early markers or monuments were engraved wood posters or rocks, or sometimes sod squares stacked high enough to be obvious.

During a 200-year period, cadastral surveyors of the public domain have identified the boundaries they survey by establishing more than seven million monuments. In the early days of the cadastral surveying program, corners were marked by native materials or wooden stakes—an easy prey for time and the elements. On the prairie, corners were often marked by digging pits.

Early in the twentieth century, however, a more permanent type of monument was inaugurated—standard metal posts manufactured from wrought iron or copper-bearing steel pipes filled with a core of concrete and with a brass cap riveted to the top of the post for appropriate marking of the position of that particular corner.

In order to insure accuracy in public and private land identification, Congress on March 4, 1909, enacted a law to protect cadastral survey markers against vandalism. As reenacted in 1948 as section 1858 of title 18, United States Code, the law reads:

Whoever willfully destroys, defaces, changes, or removes to another place any section corner, quarter-section corner or meander post, on any Government line of survey or willfully cuts down any witness tree or any tree blazed to mark the line of a Government survey, or willfully defaces, changes, or removes any monument or bench mark of any Government survey, shall be fined not more than $250 or imprisoned not more than 6 months or both.

The significance of the law has not been in its enforcement for rarely has this been necessary. Rather, it emphasizes to every citizen the importance of cadastral survey markers. These simple, unpretentious monuments, coupled with the other provisions of the official cadastral surveying scheme, are basic to acquisition or use of any part of the original public domain. By actually marking the lines on the ground, they create land boundaries, identify lands, determine areas upon which depend clear title to the land and the continued wise administration of the natural resources of the United States.

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BUREAU OF LAND MANAGEMENT

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WYOMING AND NEBRASKA:
2515 Warren Avenue
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(307) 772-2078

Improvements in equipment and technology continued at a rapid pace, and these advances dramatically speeded up the surveying process.

The Bureau of Land Management's Cadastral Survey Education Program

If you are thinking about surveying as your profession, the Bureau of Land Management has a cadastral survey cooperative education program that provides college students with on-the-ground experience while working toward their college degree. The program is geared toward surveying and engineering students in their sophomore year. After successfully completing your college studies and work sessions with the BLM, you are eligible to become a permanent BLM employee. The Bureau employs cadastral survey staffs in 12 State offices and in its support headquarters in Denver.

The Bureau has cooperative cadastral education programs with Michigan Technological University, Houghton; Ferris State College, Big Rapids, Michigan; California State University, Fresno; Oregon Technical Institute, Klamath Falls; University of Maine, Orono; Florida A&M University, Tallahassee; Virginia Polytechnic Institute, Blacksburg; University of Wisconsin, Madison; and the University of Southern Colorado, Pueblo.

Details on BLM's cadastral survey cooperative education program are available from:

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